



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 502 608 A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 92300675.3

(61) Int. Cl.⁵: B60R 21/00

(22) Date of filing: 27.01.92

(30) Priority: 04.03.91 US 665199

(43) Date of publication of application:
09.09.92 Bulletin 92/37

(84) Designated Contracting States:
DE FR GB

(71) Applicant: FORD MOTOR COMPANY LIMITED
Eagle Way
Brentwood Essex(GB)

(84) GB

(71) Applicant: FORD-WERKE
AKTIENGESELLSCHAFT
Werk Köln-Niehl Henry-Ford-Strasse
Postfach 60 40 02
W-5000 Köln 60(DE)

(84) DE

(71) Applicant: FORD FRANCE SOCIETE ANONYME

344 Avenue Napoléon Bonaparte B.P. 307
F-92506 Rueil Malmaison Cedex(FR)

(84) FR

(72) Inventor: Rhee, Dennis W.
5249 O'Connor Court
Bloomfield Hills, Michigan 48302(US)
Inventor: Bauch, David J.
23150 Wilson
Dearborn, Michigan 48128(US)
Inventor: Boran, Colm P.
19277 E. Harbour Village Drive
Northville, Michigan 48167(US)
Inventor: Lynch, Michael J.
19369 Pollyanna
Livonia, Michigan 48152(US)

(74) Representative: Messulam, Alec Moses et al
A. Messulam & Co., 24 Broadway
Leigh on Sea, Essex SS9 18N(GB)

(54) Airbag triggering system.

(57) A triggering system responsive to a vehicular crash for actuating a safety device ignitor (22a, 22b) which is in a passenger compartment (12) of the vehicle (14), the system comprising, a plurality of first detection means (32,34) each providing a first triggering on state in response to a deceleration force,

circuity means (10) responsive to said first triggering on state for providing a second triggering on state having a predetermined time duration,

at least one second detection means (22) for providing a third triggering on state in response to said deceleration force, and

redundancy means (10) for activating the safety device (24a,24b) during a simultaneous occurrence of both said second triggering on state and said third triggering on state, said redundancy means also activating the safety device (24a,24b) during a simultaneous occurrence of both said first triggering on state and said third triggering on state thereby providing a redundant actuation of the safety device ignitor.

EP 0 502 608 A1

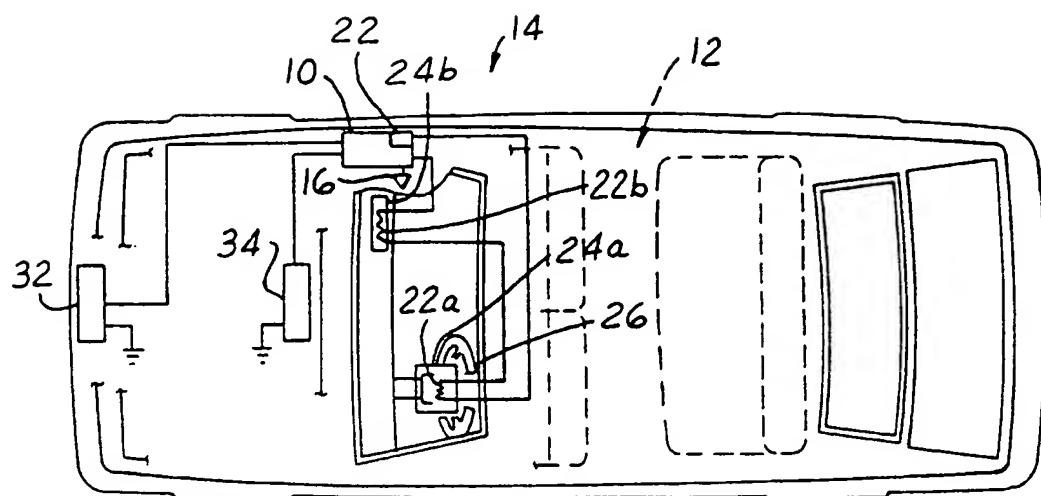


FIG. 1

The invention relates to triggering systems which activate safety devices, such as airbags, during a vehicular crash.

It has been proposed to deploy crash sensors, commonly referred to as accelerometers, in the forward area of a vehicle and connect these sensors in series between a vehicular ground, located in proximity to the sensors, and an airbag ignitor which in turn is connected to the vehicle's battery. Several sensors may be connected in parallel and the parallel combination connected in series with the ignitor.

It has also been proposed to connect a Schmidt trigger in series with a sensor to prolong activation of the ignitor. Connecting an integrator between the sensor and ignitor for allegedly extending ignition time has also been proposed as disclosed in U.S. Patent No. 4,638179 issued to Mattes.

10 The inventors herein have recognized that failure of the electrical circuitry proposed by such systems may sever the interconnection of the ignitor with vehicular ground. Further, during a vehicular crash, the interconnection between the sensor and the vehicular ground may be severed. In either event, the time during which the ignitor is activated may be reduced.

According to the invention there is provided a triggering system responsive to a vehicular crash for 15 actuating a safety device ignitor which is in a passenger compartment of the vehicle, the system comprising, a plurality of first detection means each providing a first triggering on state in response to a deceleration force,

circuitry means responsive to said first triggering on state for providing a second triggering on state having a predetermined time duration,

20 at least one second detection means for providing a third triggering on state in response to said deceleration force, and

25 redundancy means for activating the safety device during a simultaneous occurrence of both said second triggering on state and said third triggering on state, said redundancy means also activating the safety device during a simultaneous occurrence of both said first triggering on state and said third triggering on state thereby providing a redundant actuation of the safety device ignitor.

In a triggering system embodying the present invention two redundant firing paths are provided for the ignitor. One path couples electrical power through the second accelerometer, ignitor, and circuitry means to an electrical ground located within the passenger compartment which is independent of the vehicular ground located forward of the passenger compartment. Another path couples its electrical power through 30 the second accelerometer and, ignitor, and a first accelerometer to the vehicular ground. Thus, if the circuitry means should fail, a firing path is still provided through the first and a second accelerometer. Further, if the first accelerometers should become disconnected from vehicular ground as a result of the vehicular crash, a firing path is still provided through the circuitry means to the passenger compartment ground which is independent from the vehicular ground located within the vehicle's crush zone. Further the 35 activation of any first accelerometer during a crash will result in activation of the circuitry means for the predetermined time (i.e., dwell time) thereby assuring activation of the ignitor regardless of the status of the first accelerometers during the crash.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which :

40 Figure 1 is a schematic representation of a motor vehicle showing general placement of the airbags, sensors, and electrical module 10;

Figure 2A is an electrical schematic of electrical module 10 and its interconnection with the sensors shown in Figure 1;

45 Figure 2B is an electrical schematic of the reserve power supply 126 shown in Figure 1 which is coupled to the electrical ignitors of the airbag system;

Figure 2C is an electrical schematic of the reserve power supply 50 shown in Figure 1 which powers .PA the electrical circuitry of electrical module 10;

Figure 2D is an electrical schematic of the self-test circuitry shown in Figure 1; and

Figures 3A-3E show various electrical waveforms associated with the circuitry shown in Figure 2A.

50 Referring first to the example presented in Figure 1, electronic electrical module 10 is shown positioned within passenger compartment 12 of motor vehicle 14. As described in greater detail later herein with particular reference to Figures 2A-2D, module 10 is coupled to battery power V_B , ignition power V_I and instrument panel electrical ground 16 located within passenger compartment 12. Sensor 22, an accelerometer responsive to vehicular forces of acceleration and deceleration, is shown positioned within passenger compartment 12 and coupled to instrument panel ground 16. In this particular example, sensor 22 is shown positioned within electrical module 10 although other locations in proximity to passenger compartment 12 may be used to advantage. For the particular application described herein, sensor 22 is a ball and tube sensor sold by Breed Company as part no. F2DB - 14B007 with a preselected sensitivity to

deceleration.

Electrical module 10 is coupled to electrical ignitor 22a of airbag module 24a, a conventional chemically actuated airbag with electrical ignitor in this particular example, which is positioned within steering wheel assembly 26. Module 10 is also shown connected to electrical ignitor 22b of airbag module 24b shown positioned on the passenger side of passenger compartment 12. Although a protection system is shown having two airbags in particular locations, it is recognized that the invention may be used to advantage with any number of airbags and the invention is not limited to any particular airbag locations. Further, the invention may be used to advantage with protection devices other than airbags such as seat belt restraint systems.

10 Sensor 32 and sensor 34, both accelerometers sold by Breed Company as part nos. F2DB-14B006 and F2DB-14B004 in this particular example, are shown positioned forward of passenger compartment 12 in what is referred to as the crush zone of vehicle 14. Sensor 32 is shown connected in series between module 10 and a vehicular electrical ground located in physical proximity to sensor 32 within the crush zone of vehicle 14. Similarly, sensor 34 is shown electrically connected in series between module 10 and a 15 vehicular ground located in physical proximity to sensor 34. In this particular example, sensors 32 and 34 are adjusted to have a lower sensitivity to vehicular deceleration than the sensitivity of sensor 22. It is also noted that the invention described herein is not limited to a particular number, or specific location, of sensors.

An electrical schematic of module 10, ignitors 22a-b, and sensors 22, 32, and 34 is shown in Figure 2A. 20 Sensors 32 and 34 are shown connected between the vehicular ground, located within the vehicle crush zone, and node 45. Resistor 46 is shown connected between node 45 and node 47. Reserve power supply 50, which is described in greater detail later herein with particular reference to Figure 2C, is shown providing voltage Vreg to node 47. Resistor 52 is connected in series between node 47 and node 53. Capacitor 54 is shown having its positive plate connected to node 53 and its negative plate connected to 25 node 45. Resistor 56 is connected in series between node 53 and the base terminal of transistor 58, and NPN transistor in this example having its emitter electrode coupled to node 45 and its collector electrode coupled to node 60. Resistor 62 is shown coupled in series between the gate electrode of transistor 58 and node 45.

Resistor 52 and capacitor 54 form an RC circuit for charging capacitor 54 at time constant TC1 when 30 either sensor 32 or sensor 34 are actuated. Resistors 56 and 62 form a divider network for applying a portion of electrical power at node 53 to the gate electrode of transistor 58 as capacitor 54 is being charged. Capacitor 64, which is shown coupled in series between the base of transistor 58 and node 45, provides transient filtering. Diode 68, connected between the base and emitter electrodes of transistor 58, and diode 70, connected between the emitter and collector of transistor 58, prevent false triggering by 35 voltage transients at node 45.

As described in greater detail later herein with particular reference to Figures 3A-3F, the above described circuitry provides prefiltering to the turn on of transistor 58. That is, before transistor 58 is turned on, node 45 must be at ground potential for a preselected time which is determined by the charging of capacitor 54. This prefiltering may be used to advantage for filtering electromagnetic noise at node 45. It 40 may also be used to filter sensors 32 and 34 in applications where these sensors have very high response sensitivity.

Continuing with Figure 2A, circuitry within module 10 for electronically adding a dwell period for prolonging the on-state of transistor 78 is now described. Capacitor 74 is shown having its positive electrode connected to node 47 and its negative electrode connected to node 76. Transistor 78, a PNP 45 transistor in this example, is shown having its emitter electrode connected to node 47. Resistor 82 is shown connected in series between node 76 and the base electrode of transistor 78. As described in greater detail later herein with particular reference to Figures 3A-3F, capacitor 74 is discharged through resistors 82 and 86 at time constant TC2 after transistor 58 is turned on. This discharge provides a minimum on time for transistor 78 (i.e., dwell) after transistor 58 is turned on.

50 Capacitor 90 is shown coupled between the emitter and base electrodes of transistor 78 providing transient filtering in a conventional manner. Diode 92 is shown having its anode connected to node 76 and its cathode connected to resistor 94 which in turn is connected in series to the collector electrode of transistor 58. Resistor 94, having a relatively low resistance value such as 10 ohms, provides a relatively fast charging of capacitor 74 upon turn on of transistor 58. Diode 92 is utilized as a blocking diode for 55 preventing resistor 46 from recharging capacitor 74 upon opening of either sensors 32 or 34.

A description of the transistor output stage of module 10 is now described with continuing reference to Figure 2A. Resistor 98 and diode 102 are shown connected in series between the collector electrode of transistor 78 and node 105. Transistor 108, an n-channel enhancement mode MOSFET in this example, is

shown having its gate electrode connected to node 105 and its source electrode connected to electrical ground 16 of the instrument panel. Zener diode 110 is shown coupled between the source and gate electrodes of transistor 108 for providing overload protection thereto in a conventional manner. Capacitor 112 and resistor 114 are shown coupled between the gate and source electrodes of transistor 108 for providing conventional transient filtering. Additional protection for transistor 108 is provided by Zener diode 116 shown having its cathode connected to the drain of transistor 108 and its anode connected to node 118. Diode 120 is shown coupled between node 118 and the gate of transistor 108. Resistor 122 is shown coupled in series between node 118 and electrical ground 16. Transistor 108 acts as a power driver which is actuated during the on-time of transistor 78 as described further hereinbelow.

Continuing with Figure 2A, the interconnection of sensor 22 within module 10 is now described. Sensor 22 is shown coupled between node 128 and the voltage output (V_R) of reserve power supply 126 which is described in detail later herein with particular reference to Figure 2B. Ignitor 22a (external to module 10) is shown connected between node 128 and the anodes of both diodes 130 and 136 via node 129. Similarly, ignitor 22b (external to module 10) is shown connected between node 128 and node 131 which in turn is connected to the anodes of both diodes 132 and 134. The cathodes of diodes 130 and 134 are connected to the drain electrode of transistor 108, and the cathodes of diodes 132 and 136 are connected to node 45. Diodes 130, 132, 134, and 136 provide electrical isolation of ignitors 22a-b during diagnostic procedures and any shorting of sensors 32 or 34. They also prevent latching of transistor 108 after crash sensing.

In accordance with the above description, ignitors 22a-b are electrically actuatable through either of two parallel firing paths. The first firing path includes the interconnection of reserve power supply 126, sensor 22, diodes 130 and 134, transistor 108, and passenger compartment ground 16. The second firing path includes the electrical interconnection of reserve power supply 126, sensor 22, diodes 132 and 136, either sensor 32 or 34, and vehicular ground. Thus, when sensor 22 is actuated concurrently with either sensor 32 or 34, ignitors 22a-b are electrically actuated. In addition, ignitors 22a-b are electrically actuated during the dwell or on-time of transistor 108, as provided by transistor 78, and concurrent closure of sensor 22. Two redundant firing paths for ignitors 22a-b are thereby provided.

In the event of electrical failure in the circuitry of module 10, a firing path is still provided through the interconnection of sensor 22 and either sensors 32 or 34. Further, if sensors 32 and 34 become disabled during the crash, such as by destruction of their vehicular ground interconnection, a firing path is still provided through module 10 (during its dwell time) and sensor 22.

Continuing with Figure 2A, conventional microprocessor 150 is shown providing self test signal ST to self test circuitry 154. As described in greater detail later herein with particular reference to Figure 2D, self test circuitry couples a negative going pulse to node 45 to simulate closure of sensors 32 and 34. Microprocessor 150 monitors various points on module 10 such as nodes 129 and 131 for providing diagnostic signal SD to locations external from module 10 such as the electronic engine controller, dashboard volt indicator lights, or external testing stations.

Referring now to Figure 2B, and also continuing with Figure 2A, reserve power supply 126 is now described. In general terms, reserve power supply 126 is a flyback type boost circuit which raises battery voltage V_B to a higher value (25 volts in this particular example) than V_B by charging capacitor 160 through the resistance of inductor 162 and resistor 166. Reserve power supply 126 provides the A/D input of microprocessor 150 with voltage signal V_m which is proportional to its output voltage V_R . In response, microprocessor 120 provides output signal Sb to voltage supply 126 for charging capacitor 160 as explained in greater detail herein.

Inductor 162 and resistor 166 are shown coupled in parallel between ignition voltage V_I and the collector of transistor 170 which is a NPN transistor in this particular example. The emitter of transistor 170 is shown coupled to passenger compartment ground 16 as is the negative plate of capacitor 160. A resistive voltage divider including resistors 174 and 176 is shown coupled to the base electrode of transistor 170 and passenger compartment ground 16. This resistive voltage divider is connected to signal Sb from microprocessor 150 for providing a proportional signal to the base electrode of transistor 170.

Blocking diode 180 is shown having its anode connected to the collector terminal of transistor 170 and its cathode connected to the positive plate of capacitor 160. Diode 182 is shown having its anode connected to the positive plate of capacitor 160 and its cathode connected to node 184 which provides reference output voltage V_R to sensor 22. Diode 182 prevents battery current from charging capacitor 160 when the vehicular ignition is off. Isolation diode 188 is shown having its cathode connected to node 184 and its anode connected to battery voltage V_B for isolating capacitor 160 from the battery. A resistive divider network including resistors 190 and 192 is shown coupled between node 184 and passenger compartment electrical ground 16 for providing signal V_m to the A/D input of microprocessor 150. Accordingly, signal V_m provides microprocessor 150 with an input proportional to reference signal V_R from reserve voltage supply

126.

During operation, when the vehicular ignition is first turned on, signal Sb from microprocessor 150 is at a zero level. The parallel resistive combination of resistor 166 and inductor 162 provides current to capacitor 160 via diode 180 thereby charging capacitor 160 to ignition voltage V_I (12 volts in this particular example).

5 Since signal V_m provided by reserve voltage supply 126 will then indicate that reference voltage V_R is less than its desired value (12 volts rather than the desired 25 volts in this particular example), microprocessor 150 will toggle boost signal Sb between zero and five volts at a frequency of 760 Hz in this particular example. During each positive transition of boost signal Sb, transistor 170 will turn on providing current flow through inductor 162, and transistor 170 to passenger compartment electrical ground 16.

10 When boost signal Sb switches to a low voltage (such as 0 volts), transistor 170 turns off interrupting the current flow through inductor 162 and resistor 166. However, inductor 162 develops inductive "kick" by developing a large voltage across its terminals. As the corresponding voltage at the collector terminal of transistor 170 becomes greater than the voltage on the positive plate of capacitor 160, diode 180 becomes forward biased thereby further charging capacitor 160.

15 As boost signal Sb is recycled, the charge on capacitor 160 continues to increase as previously described herein. This process continues until signal V_m indicates that desired reference voltage V_R has reached its desired value. At this time, microcomputer 150 holds boost signal Sb at zero voltage. When reference signal V_R decays a predetermined amount, as indicated by signal V_m , microprocessor 150 reinitiates boost signal Sb as described hereinabove. Accordingly, reference voltage V_R is maintained at a 20 desired high voltage. In addition, reference voltage V_R is assured despite any damage which may occur to the vehicular battery or the vehicular ground located in the vehicle's crush zone.

Referring now to Figure 2C, an electrical schematic for reserve power supply 50 is shown. Signal Sr, which is provided by microprocessor 150 in a high voltage state during ignition key on, is shown coupled to node 194. Pull up resistor 198 is connected between a module voltage source (5 volts in this particular 25 example) and node 194 for providing an additional current source to signal Sr. Resistor 198 is shown connected between node 194 and the base electrode of transistor 202 which is a NPN transistor in this example. Resistor 204 is shown connected between the base and emitter electrodes of transistor 202. The combination of resistors 198 and 204 form a voltage divider for presenting a portion of signal Sr to the base electrode of transistor 202.

30 Capacitor 210 is shown having its negative electrode connected to the emitter of transistor 202 which in turn is connected to passenger compartment ground 16. The positive plate of capacitor 210 is shown connected to node 208. Zener diode 212 has its anode connected to the collector terminal of transistor 202 and its cathode connected to node 208 for regulating the voltage across capacitor 210 during the on state of transistor 202 thereby providing a regulated output voltage (V_{reg}) from reserve power supply 50. Diode 214 35 and resistor 216 are shown connected in series between battery voltage V_B and terminal 208. Diode 214 provides protection against a grounded battery terminal and resistor 216 provides bias current to Zener diode 212.

In operation, during the ignition key off state, capacitor 210 is charged to battery voltage V_B through the series interconnection of diode 214 and resistor 216. During the ignition on state, microprocessor 150 40 provides signal Sr to node 194 for turning on transistor 202. The anode of Zener diode 212 is thereby pulled to ground, providing a voltage reference at the breakdown voltage of Zener diode 212 (10 volts in this particular example) for capacitor 210. Accordingly, output voltage V_{reg} is regulated to a substantially constant value by Zener diode 212 regardless of variations in battery voltage V_B . Previously described timing values provided by module 10, such as prefiltering and dwell time, are therefore not affected by 45 battery voltage V_B and remain substantially constant during all vehicle operating conditions.

Operation of the self test mode is now described with reference to Figure 2D and continuing reference to Figure 2A. Self test module 154 is shown having node 230 coupled to self test output ST of microprocessor 150 and the base electrode of transistor 232 which is a NPN transistor in this particular example. Transistor 232 is shown having its collector electrode coupled to node 45 through the series 50 connection of isolation diodes 236, and 238 and also having an emitter electrode coupled to passenger compartment electrical ground 16 via resistor 242. The parallel combination of resistor 244 and capacitor 246 is shown coupled between the base electrode of transistor 232 and passenger compartment electrical ground 16 which, with series resistor 243 coupled to the base electrode, provides conventional filtering of voltage transients. The series interconnection of reference voltage diodes 250 and 252 is also shown 55 coupled between the base electrode of transistor 232 and passenger compartment electrical ground 16. When transistor 232 is turned on, series resistor 242 provides current limiting and, accordingly, additional protection against activating ignitors 22a-b in the event of a failure in self test circuitry 154.

During self test operation, such as after activating the vehicular ignition, microprocessor 150 provides

self test signal ST having a high voltage state (such as 5 volts) to the base of transistor 232 via series resistor 243. In response, transistor 232 turns "on" thereby coupling node 45 to passenger compartment electrical ground 16 during the high voltage state of signal ST. If the circuitry of module 10 is operating properly, transistor 108 will turn "on" at the beginning of self test signal ST and remain "on" for dwell time t_d thereafter. Modes 129 and 131 (coupled to pull up resistors which are not shown) will be in a low voltage state during the "on" time of transistor 108. Microprocessor 150 monitors nodes 129 and 131 to verify that module 10 is properly responding to self test signal ST. In the event nodes 129 and 131 do not transition to low voltage state in response to self test signal ST, microprocessor 150 provides an indication of faulty operation via signal SD.

10 Operation of module 10, responsive to sensors 22, 32, and 34, is now described with particular reference to the electrical waveforms shown in Figures 3A-3F and reference to Figure 2A. As shown in Figure 3A, a hypothetical actuation of sensor 32 is shown between times t_1 and t_3 . During this time interval, sensor 32 is positioned in the "on state" coupling electrical ground to node 45. A current path is thereby created from reserve power supply 50, resistor 52, and capacitor 54 to electrical ground. Accordingly, 15 capacitor 54 begins charging at time constant T_C ; (see Figure 3B). By time t_2 a sufficient voltage is reached to turn on transistor 58 via a voltage divider provided by resistors 56 and 62 (see Figure 3C). This time period, between t_1 and t_2 , is referred to as prefiltering time t_p .

When sensor 32 is activated for a time period at least equivalent to prefiltering time t_p , capacitor 54 charges sufficiently to turn on transistor 58. On the other hand, when sensor 32 is activated for less than 20 prefiltering time t_p , capacitor 54 does not reach a sufficient charge to turn on transistor 58 and the ground state on node 45 is ignored. This circuitry is used to advantage for filtering out electromagnetic noise which might otherwise cause an erroneous crash indication. This prefiltering circuitry may also be utilized to compensate for a highly sensitive crash sensor which, in certain applications, may be activated by forces of deceleration other than those caused by actual vehicular crashes.

25 Referring now to Figure 3D, and continuing with Figure 2A, operation of module 10 for generating dwell time t_d is described. During the "on" time of transistor 58, V_{76} is at a relatively low voltage and, accordingly, transistor 78 is maintained in its "on" state. Further, capacitor 74 becomes fully charged by current flowing through capacitor 74, diode 92, resistor 94, and transistor 58. When either sensor 32 or sensor 34 opens (time t_3), transistor 58 is switched off, however, transistor 78 remains "on" while capacitor 30 74 discharges. More specifically, current flows from the positive plate of capacitor 74 through resistors 86 and 82 to the negative plate of capacitor 74. The corresponding voltage at this negative plate (i.e., V_{76}) is shown rising exponentially beginning at time t_3 in Figure 3D. Transistor 78 remains in its "on" state until V_{76} reaches a sufficiently high voltage to turn transistor 78 off as shown at time t_{10} in Figures 3E and 3F.

In accordance with the particular example presented above, transistor 78 remains in its "on" state until 35 time t_{10} even though sensors 32 and 34 return to an open state at time t_3 . The time interval t_3-t_{10} is referred to as dwell time t_d which represents an extension of the time response of sensors 32 or 34 to a crash. Transistor 108 essentially follows the state of transistor 78, via voltage V_{105} . As shown in the particular example presented in Figure 3F, transistor 108 is "on" between time t_2 (a prefiltering time after sensors 32 or 34 first respond to a deceleration force) and time t_{10} (the end of dwell time t_d).

40 As previously discussed herein, transistor 108 is connected in series between sensor 22, ignitors 22a-b, and passenger compartment electrical ground 16. Transistor 108 is also connected in parallel to sensors 32 and 34. Thus, during vehicular deceleration, electrical power is supplied to ignitors 22a-b whenever sensor 22 closes during dwell time t_d . Further, should the circuitry of module 10 fail to provide dwell time t_d , electrical power will still be applied to ignitors 22a-b when sensor 22 is closed concurrently with either 45 sensor 32 or sensor 34.

For the particular embodiment presented herein a table of various electrical values which have been used to advantage is presented below. Those skilled in the art will recognize that neither the invention described herein, nor the particular embodiment presented herein which utilizes the invention to advantage, are limited by the values presented in this table.

50 This concludes the Description of the Preferred Embodiment. The reading of it by those skilled in the art will bring to mind many modifications and alterations which do not depart from the spirit and the scope of the invention claimed later herein. For example, any number of crash sensors, and both parallel and series interconnections thereof, may be used to advantage with the invention claimed herein. Further, the invention claimed herein may be used to advantage with circuitry other than the particular circuitry shown 55 by the illustration of module 10. Accordingly, the invention is to be limited only by the following claims.

TABLE:

	<u>Resistors</u>		<u>Capacitors</u>	
5	94	10 Ω	64, 90, 112, 246	.01 μF
	216	220 Ω	54, 74,	2.2 μF
10	62	390 Ω	210	100 μF
	56	750 Ω	160	2200 μF
	52, 98, 122		1 KΩ	
	242		1.5 KΩ	
15	174, 196		2.2 KΩ	
	198		3.3 KΩ	
	166		4.7 KΩ	
20	46, 82, 176, 204,			
	243, 244		10 KΩ	
	86, 114		22 KΩ	
25	192		24.9 KΩ	
	190		100 KΩ	
30				
	<u>Diodes</u>			
	68, 70, 120, 130, 132,			
	134, 136, 182, 188		EGP20D	
35				
	92, 102, 180, 214			
	236, 238, 250, 252		IN4004	
40				
	110		8.2V Zener	
	212		10V Zener	
45	116		39V Zener	

Claims

- 50 1. A triggering system responsive to a vehicular crash for actuating a safety device ignitor (22a, 22b) which is in a passenger compartment (12) of the vehicle (14), the system comprising, a plurality of first detection means (32,34) each providing a first triggering on state in response to a deceleration force, circuitry means (10) responsive to said first triggering on state for providing a second triggering on state having a predetermined time duration, at least one second detection means (22) for providing a third triggering on state in response to said deceleration force, and redundancy means (10) for activating the safety device (24a,24b) during a simultaneous occurrence of both said second triggering on state and said third triggering on state, said redundancy means also

activating the safety device (24a,24b) during a simultaneous occurrence of both said first triggering on state and said third triggering on state thereby providing a redundant actuation of the safety device ignitor.

- 5 2. A triggering system as claimed in claim 1 wherein said first detection means and said second detection means each comprise accelerometers.
- 10 3. A triggering system as claimed in claim 1 wherein said second detection means has a greater sensitivity than said first detection means.
- 15 4. A triggering system as claimed in claim 1 further comprising an airbag system coupled to said safety device ignitor.
- 20 5. A triggering system as claimed in claim 1 further comprising an auxiliary power supply independent of the vehicular battery and is coupled to the safety device by said activation of the safety device.
- 25 6. A triggering system as claimed in claim 5 wherein said auxiliary power supply includes charging means for storing an output voltage greater than vehicular battery voltage.
- 30 7. A triggering system for applying electrical power to an electrical ignitor of an airbag positioned in a passenger compartment of a motor vehicle, comprising:
 - a plurality of first accelerometers each being electrically connected between the electrical ignitor positioned within the passenger compartment and a vehicular ground;
 - circuitry means electrically connected between said electrical ignitor and an electrical ground for providing a conductive state during a predetermined time after actuation of any of said first accelerometers; and
 - a second accelerometer electrically connected in series between said electrical ignitor and a source of electrical power for coupling electrical power through said electrical ignitor to said vehicular ground upon simultaneous actuation of said second accelerometer and any of said first accelerometers, said electrical power also being coupled through said electrical ignitor to said electrical ground upon actuation of said second accelerometer concurrently with said conductive state of said circuitry means.
- 35 8. A triggering system as claimed in claim 7 wherein said electrical ground is independent of said vehicular ground.
- 40 9. A triggering system as claimed in claim 7 wherein said circuitry means further comprises prefiltering means for providing said conductive state after actuation of said first accelerometers for a preselected time.
- 45 10. A triggering system as claimed in claim 7 wherein said source of electrical power provides said electrical power after disconnection of the vehicular battery.
- 50 11. A triggering system as claimed in claim 10 wherein said source of electrical power includes charging means for storing a voltage greater than vehicular battery voltage.
- 55 12. A triggering system for applying electrical power to an electrical ignitor of an airbag positioned in a passenger compartment of a motor vehicle, comprising:
 - a plurality of first accelerometers positioned forward of the passenger compartment, each being electrically connected between the electrical ignitor located within the passenger compartment and a vehicular ground located forward of the passenger compartment for providing a conductive path therebetween upon actuation by a vehicular deceleration force;
 - an electrical module positioned in the passenger compartment having a power supply located thereon with an electrical ground independent of said vehicular ground;
 - circuitry means positioned on said module and electrically connected between said electrical ignitor and said independent electrical ground for providing a conductive state for a predetermined time after any of said first accelerometers have provided said conductive path for a preselected time; and
 - a second accelerometer electrically connected in series between said electrical ignitor and said power supply for coupling electrical power through said electrical ignitor to said vehicular ground upon

EP 0 502 608 A1

simultaneous actuation of said second accelerometer and any of said first accelerometers, said second accelerometer also coupling said electrical power through said electrical ignitor to said independent ground upon actuation of said second accelerometer concurrently with said conductive state of said circuitry means.

5

10

15

20

25

30

35

40

45

50

55

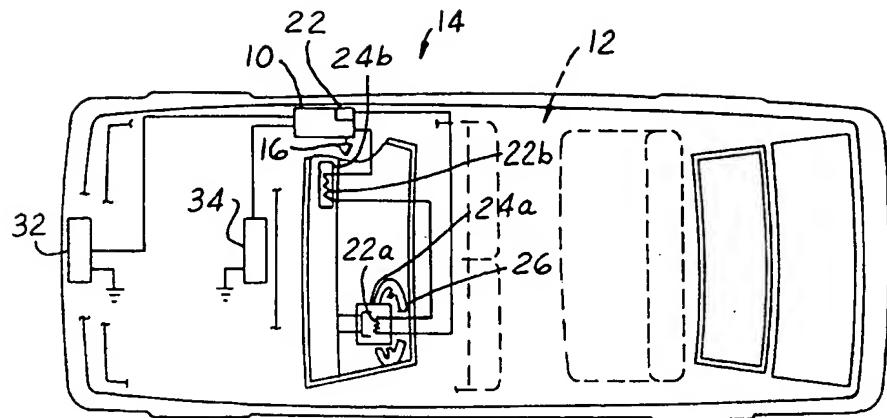


FIG. 1

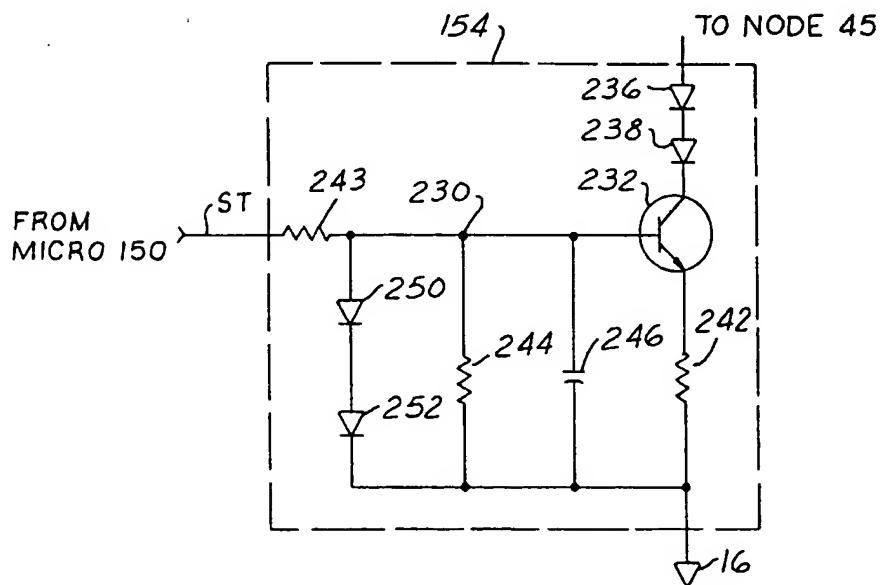


FIG. 2D

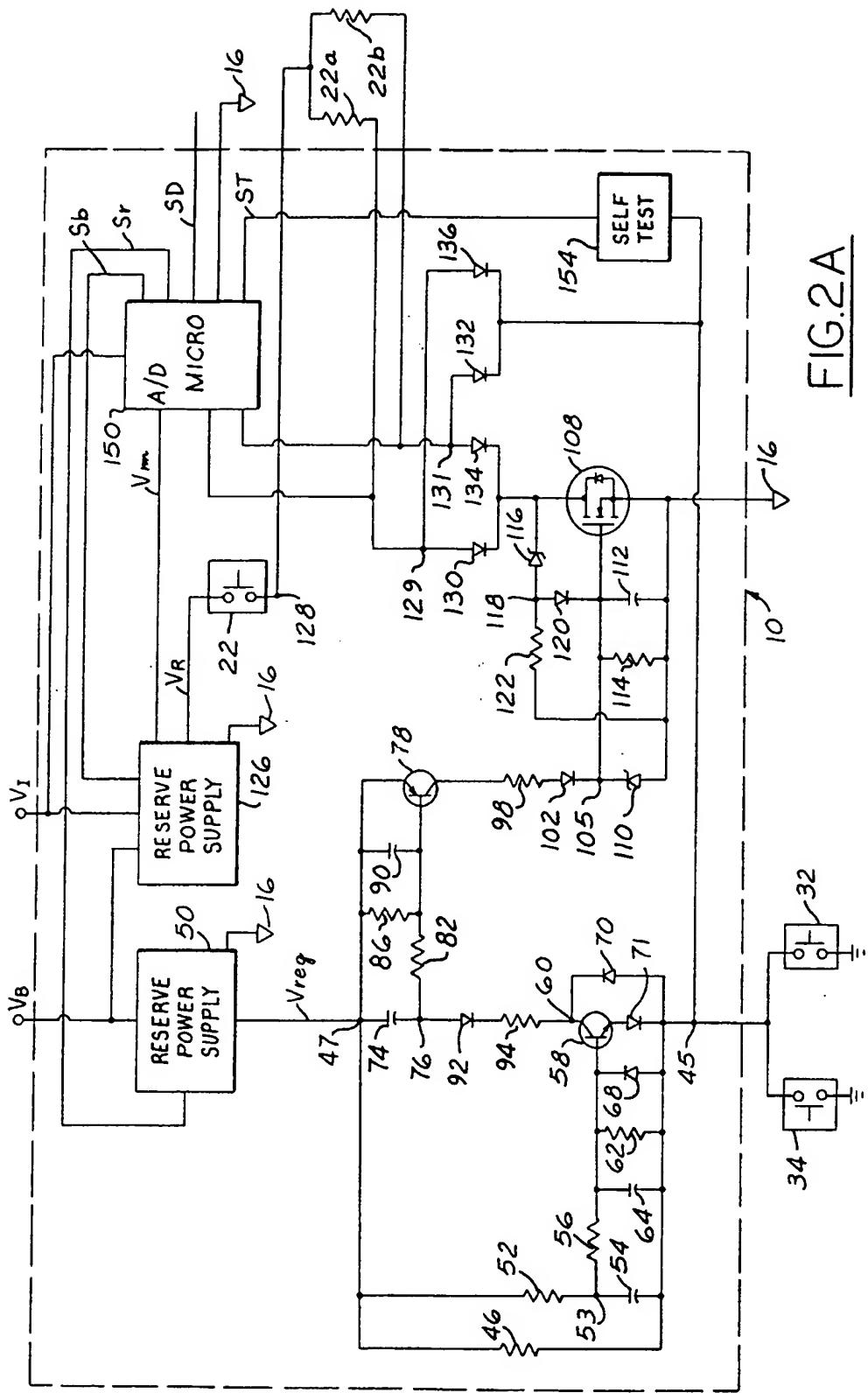
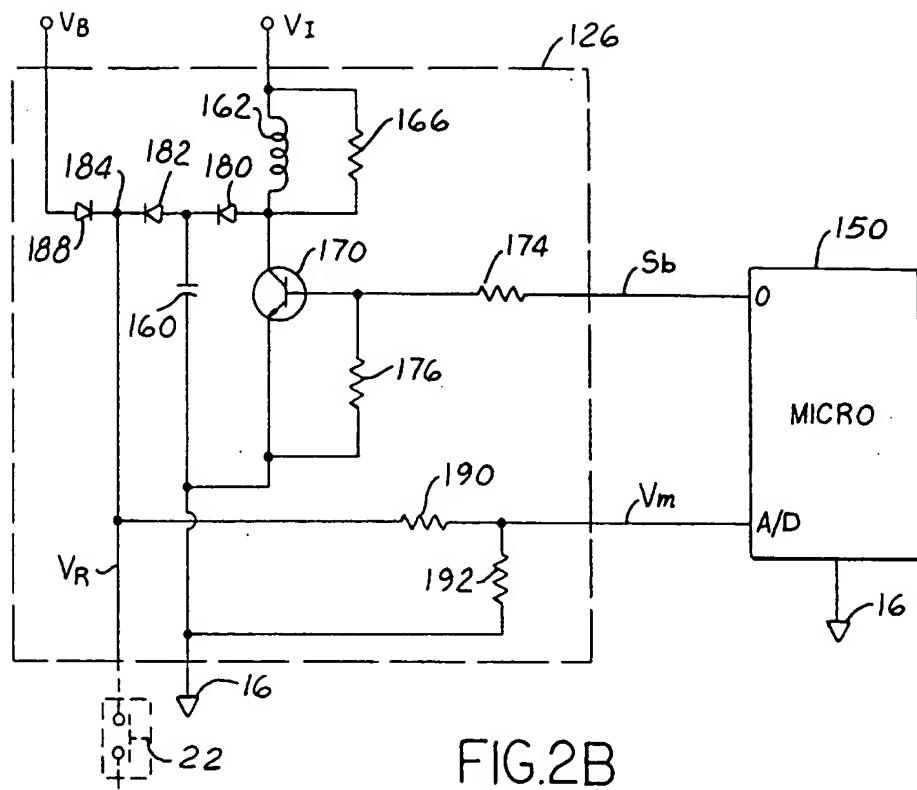
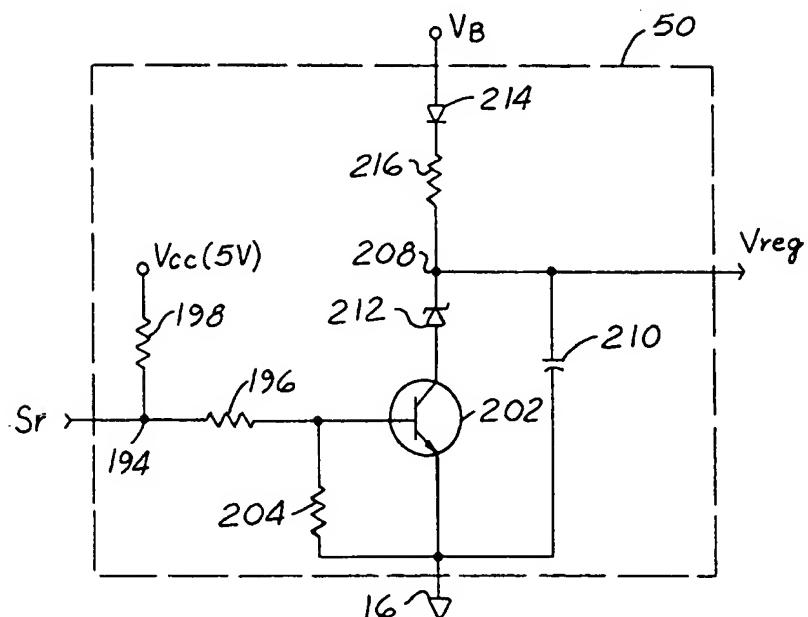


FIG.2A

FIG.2BFIG.2C

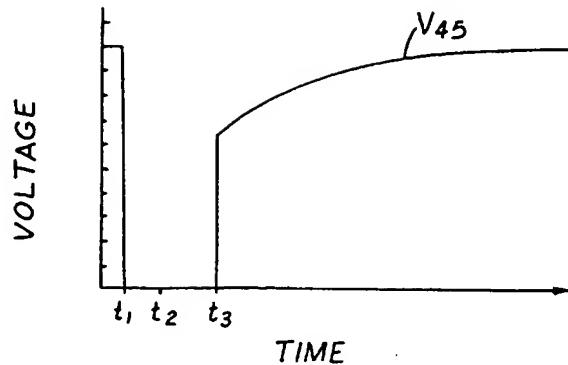


FIG.3A

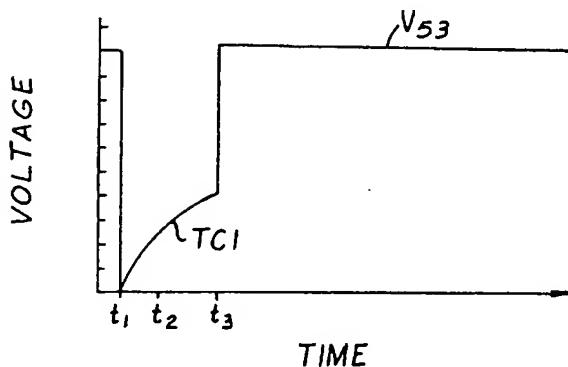


FIG.3B

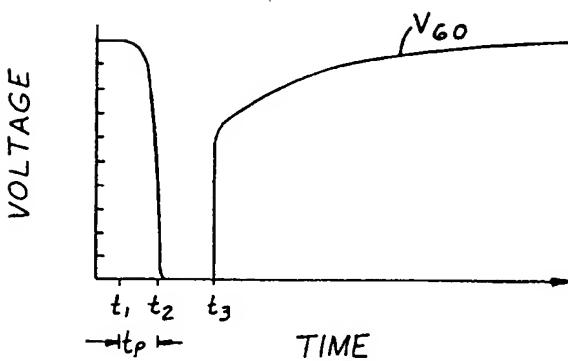


FIG.3C

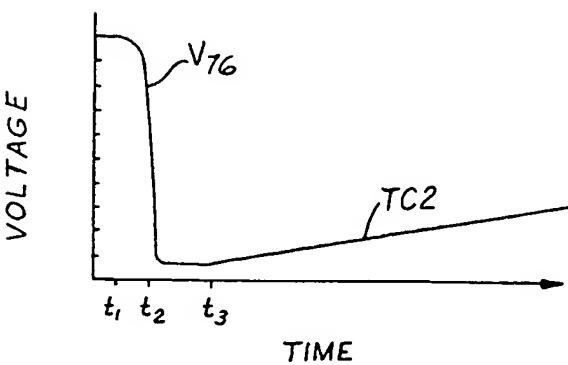


FIG.3D

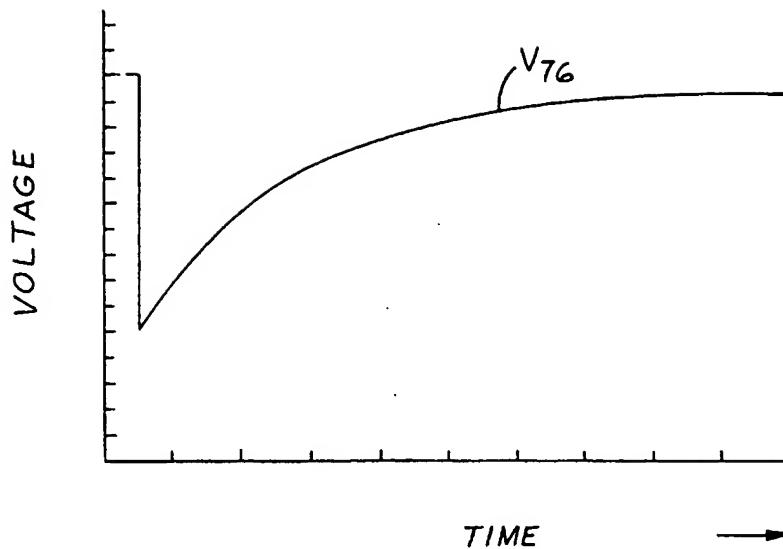


FIG.3E

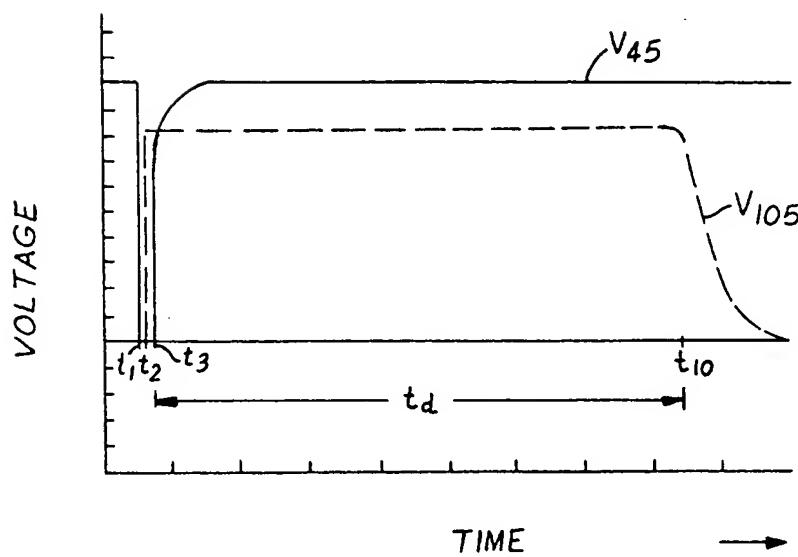


FIG.3F



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 0675

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	US-A-3 863 208 (M.S. BALBAN) * column 3, line 1 - column 13, line 17; figure 1 *	1-7,9-12	B60R21/00
Y	US-A-3 633 159 (N.E. DILLMAN) * abstract * * column 1, line 46 - column 7, line 21; figures 1,2 *	1-7,9-12	
A	EP-A-0 344 788 (NIPPONDENSO CO. LTD.) * abstract * * column 5, line 17 - column 13, line 16; figures 1,4 *	1,2,4,7, 9,12	
D,A	US-A-4 638 179 (B.MATTES ET AL.) * column 2, line 62 - column 4, line 68; figures 1-3 *	1,2,7,9, 12	
	-----		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B60R
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	12 JUNE 1992	VAN DER VEEN F.	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone			
Y : particularly relevant if combined with another document of the same category			
A : technological background			
O : non-written disclosure			
P : intermediate document			